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Synopsis

on

Study on hydrobiological factors of different Makhana growing areas especially Darbhanga district, and their quantitative and qualitative analysis for improved yield

(For the award of Ph. D. Degree in the faculty of science)
[Botany]

Submitted to

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INTRODUCTION:

North Bihar districts including Darbhanga is traversed by a number of perennial rivers, ponds land depressions (locally called **Chaurs**), ox-bow lakes (natively called **Mauns**), swamps ditch etc. Bowl-shaped physiography of these regions makes these a recurrent site of water logging without natural outlets. Its average rainfall is around 1200 mm. All these water bodies are utilized for rearing fishes & for the cultivation of deep-water paddy, Makhana and Singhara. Of these, **Makhana** provides a means of sustainable development in these areas. It is a plant of tropical & sub-tropical climates with significant bearing on the regional economy. Makhana seeds are also called as "Black Diamond". *Euryale ferox* (also known as fox nut; makhana Gorgon plant) is the only species in the genus Euryale [1].

Makhana is an angiosperm classified in the water lily family Nymphaeceae, although it is occasionally included in the distinct family of Euryalaceae also. It is a cash crop (dry fruit) and marketed in the form of popped makhana, commonly known as Makhana lawa. Makhan plant is considered as a native of North-East India, South-East Asia and China, and its distribution is limited to tropical & sub-tropical regions of South-East and East-Asia and known to exist in Japan, Nepal, Bangladesh & some parts of India. In India it is reported from West Bengal, Bihar, Assam, Tripura, Manipur, Jammu & Kashmir, eastern Odisha, Madhya Pradesh, Rajasthan, & Uttar Pradesh. However, its commercial cultivation is strictly limited to North Bihar, Manipur and some parts of West Bengal [1, 2].

In Bihar, major Makhana producing districts include Darbhanga, Sithamarhi, Madhubani, Saharsa, Supaul, Araria, Kishangunj, Purnia, and Katihar. Approx 80% of total production of processed Makhana comes from Darbhanga, Madhubani, Purnia,and Kaithar districts alone. Area under Makhana cultivation is about 13,000 ha [3, 4].

Due to its herbal and medicinal properties, it's a natural organic herbal food, helpful in reducing various critical ailments that a normal allopathic medicine can't cure [3]. Hence, occasionally it is also used as nutraceuticals. Makhana is superior to all dry fruits such as almond, walnut, coconut & cashew nut in terms of sugar, protein, ascorbic acid and phenolic content. It is even superior to many plants and animal-based diet [5, 6].

OBJECTIVES:

The knowledge & development of Makhana cultivation in Darbhanga district by implementing the methods elucidated in the present study will be helpful to the farmers actively engaged in Makhana cultivation & biodiversity hot spot has been done by adopting suitable technologies for its conservations, production & Management.

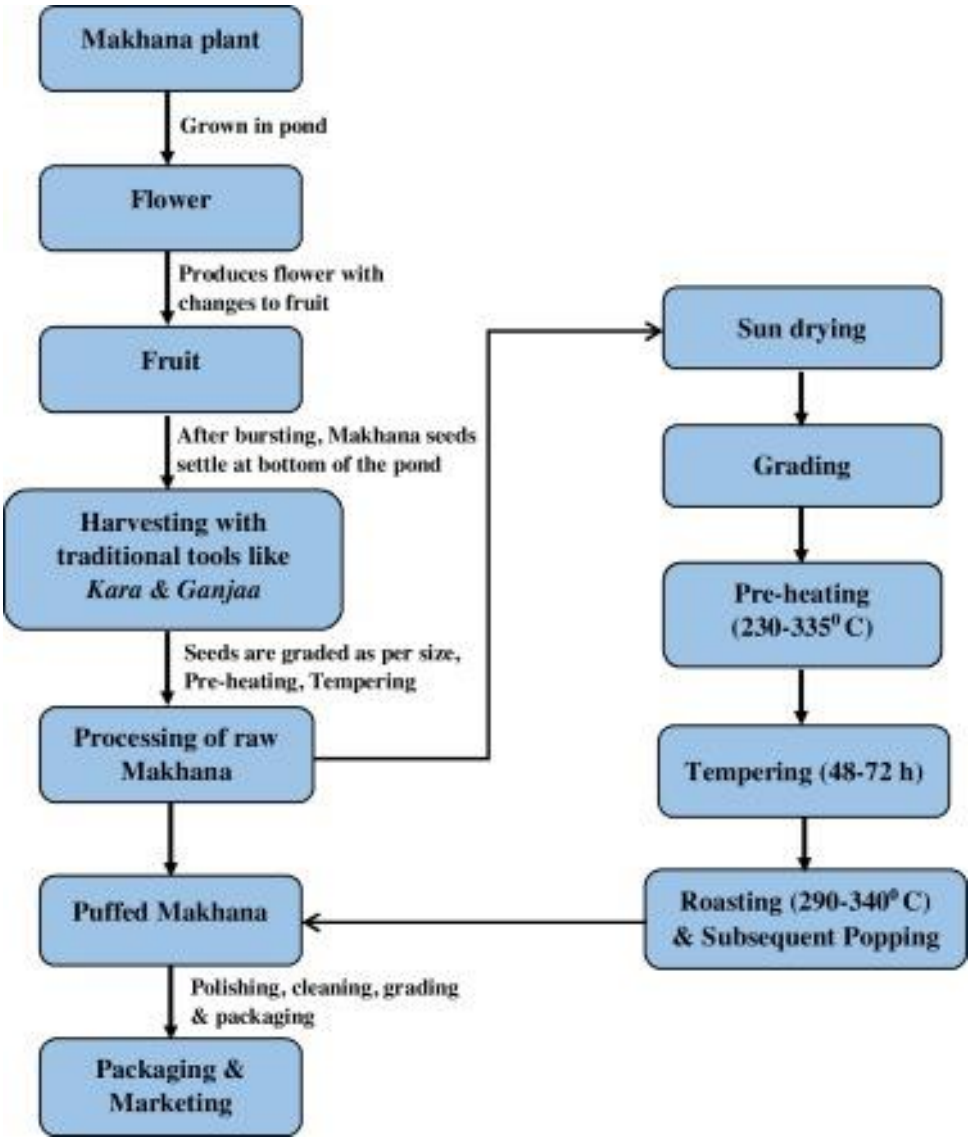
The objectives of my research work are-

1. To analyze and describe the different sites suitable for Makhana production.
2. Collection of various water and the yielded samples of there from selected stations (specially between Jan to May and that of morning hours).
3. Field analysis of the area covered to study their structural, functional & physiological conditions.
4. Analysis of various biological, physical and chemical parameters using various methods and methodologies.

METHODOLOGY:

The present study was carried out in the Darbhanga district of Bihar. The study aims at understanding the socio-economic condition of farmers cultivating Makhana (*Euryale ferox*) [5]. The brief description of methodological aspects used in the sampling techniques, collection of data and method of enquiry, period of enquiry, tools and techniques used in

analysis are applied in attaining specific objectives of the study. Purposive and random sampling techniques were used to select district, block, village, and farmers. The present study was conducted in various posts of Darbhanga district in Bihar [3, 6].


Makhana plant
Grown in pond
Flower
Produces flower with changes to fruit
Fruit
After bursting, Makhana seeds settle at bottom of the pond
Harvesting with traditional tools like Kara & Ganjaa
Seeds are graded as per size, Pre-heating, Tempering
Processing of raw Makhana
Puffed Makhana
Polishing, cleaning, grading & packaging
Packaging & Marketing
Sun drying
Grading
Pre-heating (230-335⁰ C)
Tempering (48-72 h)
Roasting (290-340⁰ C) & Subsequent Popping

Darbhanga district was purposively selected for the study, as makhana has always been the major crop of the district and Darbhanga is famous for the production of makhana in Bihar and as well as in India. Among total of 18 blocks of district Darbhanga, the main targeted blocks are Bahadurpur, Hayaghat and Sadar Darbhanga [4, 7]. A list of all the three major makhana producing blocks will be prepared. A list of all the villages practicing the makhana crop of the selected blocks will be prepared including specific village areas [8, 9].

Selection of farmers will be based upon the random process. The list of makhana cultivators of all the selected villages will be prepared with the help of the experts of Fisherman cooperative society of Darbhanga Sadar block. Among them several cultivators/makhana growers will be selected randomly from each village [7, 9, 10].

All the primary data will be collected from expert farmers, in the study area through survey method and the pre-tested schedule will be prepared specially for the purpose of the study. The collected data will be proof read and cross checked with the head of the village, to confirm the authenticity. The tabular analysis will be done by working out simple averages and percentages.

1. Analysis and the description of the different sites very suitable for Makhana production can be done using various methods like Garrett Ranking Method.

Garrett's ranking technique was used to rank the preference indicated by the respondents on different factors. As per this method, respondents have been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value. Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important factor [8, 9].

2. Analysis of biological parameters viz. Qualitative & Quantitative analysis; preservation methods and preservatives used; Culture and growth of other flora and fauna as pros and cons for Makhana production; Species diversity of Makhana indices using method of Shannon-weaver equation (1964) [10].

Good literature reviews whether qualitative or quantitative provides a good summary of works of different researchers related to that field without partiality. A literature review summarizes, synthesize and argument the works of others. A chronological and systematic review was done to analyze the different aspects of makhana cultivation including its production, value chain analysis, economics of production, constraints as well as marketing. A total of 21 research papers were published from year 2010-2021 and were reviewed to analyze the pattern, challenges and establish common themes and the results were broadly classified in 6 categories production, marketing, constraints, economics, value chain, and socio-economic profile of growers [11].

The Shannon-Weiner Species Diversity Index is calculated by taking the number of each species, the proportion each species is of the total number of individuals, and sums the proportion times the natural log of the proportion for each species [12].

5. Analysis of physical parameters include- Movement of water; Water colour estimation; Water temperature estimation; Transparency of water and turbidity of water of different sites using Nephelometer.

   Turbidity can be measured using nephelometry or turbidimetry techniques, with the former generally used for low turbidity levels and the latter for high turbidity levels. Turbidity analysis is essential for many fields with applications in areas such as sedimentology, monitoring air pollution, beer characterization, and water quality testing [13].

6. Chemical parameters' estimation include- H^+ concentration; Use of electrometric methods to measure the chemical aspects; Calorimetric method to measure the chemical aspects and that of various other parameters.

   The calorimetric method can be used for determining the TCES capacity of novel metal oxide materials. Samples are initially prepared by sintering a mixture of the raw component oxides, mixed to the desired molar ratios, at 1200 °C under 0.1 SLPM of hydrogen and 0.4 SLPM of argon for approximately 12 h to form solid structures of the pure component oxides. After preparing the material, a sample mass of approximately 2–4 g is placed within a small alumina ceramic crucible. The initial mass is recorded, as it is needed for the acid-solution calorimetry calculations [14].

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